

RESEARCH ARTICLES

ОРИГИНАЛЬНЫЕ СТАТЬИ

CEPHALANTHERA EPIACTOIDES (ORCHIDACEAE) IN RUSSIA

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Twenty species of the orchid genus *Cephalanthera* are known in the World and seven species occur in Russia. One of them, restricted in Russia to the Black Sea coastal area of the Krasnodarsky Krai in the North Caucasus, has a long story of misidentifications and taxonomic confusions. The present study revealed that the correct name for this species is *Cephalanthera epipactoides* while it was previously known in Russia as either *C. cucullata* or *C. kurdica* (= *C. floribunda*). The lectotype of *C. epipactoides* is designated. Morphological description of the species is provided with measurements of the main parameters. The distribution of *C. epipactoides* in Russia is summarised on the base of herbarium specimens, data from the «Plantarium» website, field observations, and previously published records; the species is known here along approximately 125 km from the environs of Anapa to Dzhubga. The Russian part of the species range is isolated from its main area of distribution; the nearest locality in Turkey is about 365 km away from Dzhubga (linear distance). The population quantity of the species in Russia is very low. *Cephalanthera epipactoides* is highly threatened in Russia; its conservation status is «critically endangered». Further study of the species is recommended, in particular, in relation to its pollination ecology.

Key words: Black Sea coastal area, Caucasus, distribution, lectotype, orchids, taxonomy

Introduction

With ca. 28 000 described species, the orchid family (Orchidaceae) is the second largest plant family in the World after Asteraceae (Christenhusz & Byng, 2016). At the same time, orchids are also the most threatened plants due to their complex life history strategies, charisma, and threats from overcollection and habitat loss (Pillon & Chase, 2006; Fay & Chase, 2009; Fay, 2018). Many species of orchids are going to be extinct, first of all, due to destruction of their habitats and climate change (Swarts & Dixon, 2009; Efimov, 2012). Taxonomic complexities, which affect the most appropriate delimitation of species, cause problems for their conservation (Flanagan et al., 2006; Hollingsworth et al., 2006; Cameron, 2010; Vereecken et al., 2010). Some groups of orchids are still poorly known, especially in tropical regions. Taxonomic studies of these plants, however, are continued even in temperate Eurasia. Most of them are dedicated to the complex genera *Epipactis* Zinn, *Dactylorhiza* Neck. ex Nevski, and *Ophrys* L. (Efimov et al., 2016; Jakubská-Busse et al., 2017; Bateman & Rudall,

2018; Bateman et al., 2018; Fateryga et al., 2018a,b; Zhou & Jin, 2018; Baguette et al., 2019). Other genera, which are relatively better known, however, are also studied (e.g. Bateman et al., 2017).

The Holarctic and Oriental genus *Cephalanthera* Rich. (Orchidaceae: Epidendroideae: Neottieae) contains 20 species. One of them is known from North America, five from the East Mediterranean to the Caucasus, three have a broad distribution in temperate Eurasia and a small area in North Africa, and 11 species are distributed in East and Southeast Asia (Govaerts et al., 2005–2020). Seven species are known from Russia. Among them, there are three broadly distributed taxa: *Cephalanthera damasonium* (Mill.) Druce, *C. longifolia* (L.) R.M. Fritsch, and *C. rubra* (L.) Rich. They are relatively common in the European part of Russia, including the Crimea and the North Caucasus (Averyanov, 2006; Red Data Book of the Russian Federation, 2008; Vakhrameeva et al., 2008; Fateryga et al., 2019; Ivanov, 2019). Two other species, *Cephalanthera erecta* (Thunb.) Blume and *C. longibracteata* Blume, are restricted to the Far East:

Primorsky Krai, Sakhalin, and Kuril Islands (Red Data Book of the Russian Federation, 2008; Vakhrameeva et al., 2008). The sixth species, *Cephalanthera caucasica* Kraenzl., is reported only from the Samur River delta, the southernmost locality of the Republic of Dagestan in the North Caucasus (Averyanov, 2006; Ivanov, 2019). These taxa are not problematic, although, the presence of the latter species in Russia has not been confirmed by any recent evidences.

The seventh species of *Cephalanthera*, restricted in Russia to the Black Sea coastal area of the Krasnodarsky Krai in the North Caucasus, has a long story of misidentifications and taxonomic confusions. It was firstly reported by Lipsky (1899) from «Novorossiysk–Anapa» as *Cephalanthera cucullata* Boiss. & Heldr. Then, *C. cucullata* was again reported from Novorossiysk by Fomin & Woronow (1909). In the same paper, they reported another taxon, *Cephalanthera floribunda* Woronow, but from the Artvin Province (currently Turkey). Grossheim (1928) again reported *C. cucullata*, but with *C. floribunda* as its synonym, from both territories. Actually, *C. cucullata* is a species endemic to the Island Crete while *C. floribunda* is a synonym of *Cephalanthera kurdica* Bornm. ex Kraenzl. distributed in Armenia, Azerbaijan, Turkey, Syria, Lebanon, Iraq, and Iran (Kreutz, 1998, 2004; Govaerts et al., 2005–2020; Vakhrameeva et al., 2008; Delforge, 2016). Then, the species occurring in Russia was reported in the Flora of USSR as *Cephalanthera epipactoides* Fisch. & C.A. Mey. with both *C. kurdica* and *C. floribunda* as its synonyms (Nevski, 1935). According to the modern data, *C. epipactoides* is known from Greece, Bulgaria, and Turkey; *C. kurdica* is not currently treated as its synonym (Kreutz, 1998; Govaerts et al., 2005–2020; Assyov et al., 2012; Delforge, 2016). After that, Grossheim (1940) also reported *C. epipactoides*, with *C. floribunda* as its synonym, from the Russian Black Sea coastal area and Armenia. Then, Czerepanov (1995) listed two species occurring in the Caucasus: *C. floribunda* and *C. kurdica*. After his paper, the first name became commonly used for the species occurring in Russia and Azerbaijan while the second one was used for the Armenian plants (Perebora, 2002, 2011; Dubovic, 2005; Ivanov & Kovaleva, 2005; Vakhrameeva, 2008; Vakhrameeva et al., 2008). Averyanov (2006), however, reported *C. kurdica*, with *C. floribunda* as its synonym, for the whole Caucasus and his opinion was followed by Ivanov (2019). At the same time, Zernov (2006) used the

name *C. cucullata* for the Russian plants and his opinion was accepted in the Red Data Book of Krasnodarsky Krai (Zernov & Popovich, 2017).

All taxa of the genus *Cephalanthera* mentioned above (*C. cucullata*, *C. epipactoides*, and *C. kurdica* = *C. floribunda*) belong to a monophyletic group (section *Cucullatae* Zernov) which is characterised by the presence of a spur at the base of the hypochile (Delforge, 2016). The second character of this group is short leaves, which are approximately equal in length to the corresponding internodes. These three species differ from each other mainly by flower size (smaller in *C. cucullata* and larger in *C. epipactoides* and *C. kurdica*) and coloration (bright pink in *C. kurdica* and white to yellowish or cream in *C. cucullata* and *C. epipactoides*). They are allopatrically distributed (Kreutz, 1998; Delforge, 2016). In contrast to the abovementioned Russian literature, these plants are usually not reported from Russia by foreign scientists. None of the three species were reported from this country by Delforge (2016) and even the «World Checklist of Selected Plant Families» (Govaerts et al., 2005–2020) added Russia to the distribution of *C. kurdica* only in 2018. Baumann & Künkele (1982), however, added a small area of the Russian Black Sea coast to the distributional map of *C. epipactoides* but this information was ignored by further research.

The purpose of the present study is to ascertain what species of *Cephalanthera* of the section *Cucullatae* actually occurs in Russia (*C. cucullata*, *C. epipactoides*, or *C. kurdica*) and summarise the data on its distribution within this country.

Material and Methods

Field observations were carried out in the Krasnodarsky Krai (Russia) in 2019. Plants were observed at three localities: 1) the vicinity of Kamchatka khutor, Novorossiysk urban okrug (44.711389°N, 37.626389°E) on 10.05.2019; 2) outskirts of Dzhubga, Tuapse district (44.319722°N, 38.708333°E) on 11.05.2019; 3) outskirts of Myskhako, Novorossiysk urban okrug (44.665834°N, 37.752491°E) on 15.05.2019. The first locality was an oak forest with predomination of *Quercus pubescens* Willd. and *Carpinus orientalis* Mill. The second locality was an edge of an artificial pine forest. *Pinus nigra* subsp. *pallasiana* (Lamb.) Holmboe was the main species of trees while some native species, such as *Q. pubescens*, were also present there (Fig. 1A). The third locality was a sparse forest with *Q. pubescens*, *C. orientalis*, and some individuals of *Juniperus deltoides* R.P. Adams, and *Cotinus coggygria* Scop.



Fig. 1. *Cephalanthera epipactoides* Fisch. & C.A. Mey. in Russia. A – typical habitat in Dzhubga; B – habit of a plant in flower; C, D – parts of its inflorescence.

Ten plants were randomly selected in both the first and the second locality; four additional plants were studied in the third locality (there were no more plants there). Each of these plants was measured with a metal tape measure. The measured parameters were the shoot and the inflorescence lengths as well as the length and the width of the largest leaf. Numbers of leaves and flowers were also calculated. After that, the lowest flower of the plant was cut and its straightened parts were placed between a paper and a piece of a transparent adhesive tape. These flowers were then measured in the laboratory with a vernier caliper. The measured parameters were the length of the ovary, lengths and widths of sepals and petals, the length of the lip, the width of the epichile, and the length of the column. Then, the minimum, the maximum, and the mean values were calculated for each parameter. Confidence intervals of the mean values were calculated for 95% confidence level ($p = 0.05$).

Plants were identified using several literature sources (Moore, 1980; Renz & Taubenheim, 1984; Kreutz, 1998; Delforge, 2016). A morphological description was made according to the original data.

The distribution of the species in Russia was ascertained using the data from several herbaria (KW, L, LE, MHA, PHEO, and YALT), as well as the digital version of the Herbarium MW (Seregin, 2020). The data from the «Plantarium» website (Plantarium, 2007–2020), field observation made by the authors, and published records (Zernov & Popovich, 2017) were also used. Type material was studied in the digital version of the Herbarium P (MNHN, 2020).

Results and Discussion

All studied plants of the *Cephalanthera* section *Cucullatae*, i.e. the plants with a spur at the base of the hypochile collected in the Krasnodarsky Krai of Russia, were identified as *C. epipactoides*. They had sepals up to 26 mm long and a spur up to 4 mm long while *C. cucullata* has sepals less than 20 mm long and a spur 1–2 mm long (Moore, 1980; Delforge, 2016). All plants also had pure white to yellowish-white coloration of flowers while *C. kurdica* has pink perianth at least in most specimens (Renz & Taubenheim, 1984; Kreutz, 1998; Delforge, 2016). Detailed information on *C. epipactoides* is presented below, including its nomenclature and the type, morphology, distribution, and conservation status.

Cephalanthera epipactoides Fisch. & C.A. Mey. 1854, Ann. Sci. Nat., Bot., sér. 4, 1: 30. ≡ *Cephalanthera cucullata* subsp. *epipactoides* (Fisch. & C.A. Mey.) H. Sund. 1975, Europ. Medit. Orchid.: 45. Type locality [Turkey]: «Intra Kastamboli [currently Kastamonu, Kastamonu Province] et Tuzla (Troas) [= Troy, Çanakkale Province]», **lectotype** (Kreutz, **designated here**): «Asie-Mineure», de Tchihatcheff 512 (P00345204!) (Fig. 2).

Remarks

Von Fischer & Meyer (1854) described *C. epipactoides* on the base of the material collected in Turkey by P. de Tchihatcheff in 1849. Four specimens of this species, collected by this person, are preserved in the herbarium of the Museum National d'Histoire Naturelle in Paris, France (P). Two of them, mounted together under the number P00345202, were collected between Sarnychky (currently Sagalossos) and Ağlassan at the foot of the Taurus Mountains (Pisidia), i.e. at a different location than was specified in the protologue. Two remaining specimens are also mounted together but have different numbers. Both were collected in Asia Minor but further details were not specified. Thus, they do not contradict to the protologue. Among them, P00345204 has better condition than P00345203. Therefore, the former specimen is designated as the lectotype.



Fig. 2. Lectotype of *Cephalanthera epipactoides* Fisch. & C.A. Mey. (P00345204) (right specimen).

Description

Rhizomatous perennial herbs. Plant with 1–2(6) stems. Stem erect to slightly inclined, green, glabrous, with 2–5 spirally arranged leaves. Leaves green, erect, ± equal in length to internodes; lower ones ovate, upper ones lanceolate. Inflorescence ± loose, with 5–24 flowers. Bracts similar to upper leaves, exceeding flowers, diminishing in length higher up. Flowers sessile, directed ± sideways. Ovaries green, glabrous. Perianth ± open, pure white to yellowish or cream. Sepals lanceolate; petals broadly lanceolate, shorter than sepals. Lip divided in hypochile and epichile. Hypochile concave, with two erect, rounded lateral lobes and spur at base; spur directed downwards, 3–4 mm long. Epichile cordate to triangularly lanceolate, with 7–9 creamy-white to brownish-yellow ridges (Fig. 1B,C,D). Measurements are presented in the Table.

Differences from the related taxa

Cephalanthera epipactoides is closely related to *C. cucullata* and *C. kurdica*. The species can be distinguished from *C. cucullata* by larger flowers (*C. cucullata* has sepals less than 20 mm long, spur 1–2 mm long, and epichile with 3–6 ridges). *Cephalanthera epipactoides* can be distinguished from *C. kurdica* by flower coloration (the latter species usually has a bright pink perianth). Some populations of *C. kurdica* in Turkey, however, have pale flowers but they can be also distinguished from *C. epipactoides* by the broader epichile, which is rather ovate and obtuse (Moore, 1980; Renz & Taubenheim, 1984; Kreutz, 1998; Delforge, 2016).

Table. Morphometric parameters of the studied plants of *Cephalanthera epipactoides* Fisch. & C.A. Mey.

Parameter	<i>n</i>	min–max	<i>m</i> ± <i>M</i>
Shoot length (with inflorescence), cm	24	21–51	33.7 ± 2.8
Inflorescence length, cm	24	7–25	14.6 ± 2.1
Number of leaves	24	2–5	3.4 ± 0.3
Number of flowers	24	5–24	13.7 ± 2.4
Largest leaf length, mm	14	30–52	41.0 ± 3.4
Largest leaf width, mm	14	13–28	20.4 ± 2.3
Ovary length, mm	23	8–14	11.0 ± 0.7
Upper sepal length, mm	23	17–26	20.6 ± 1.0
Upper sepal width, mm	23	4–7	5.9 ± 0.4
Lateral sepal length, mm	23	17.5–25	20.5 ± 0.7
Lateral sepal width, mm	23	5.5–8	6.5 ± 0.3
Petal length, mm	23	14–20	16.1 ± 0.7
Petal width, mm	23	5.5–8	6.6 ± 0.3
Lip length (with spur), mm	23	13–21	16.8 ± 0.8
Epichile width, mm	23	7–11	9.0 ± 0.4
Column length, mm	23	5.5–11	8.1 ± 0.5

Note: *n* – sample size, min – minimum value, max – maximum value, *m* – mean value, *M* – confidence interval (*p* = 0.05).

Specimens examined

Russia: Krasnodarsky Krai. Anapa urban okrug: Anapa, 02.05.1892, Lipsky (LE01038192). Novorossiysk urban okrug: Novorossiysk, 12.05.1892, Lipsky (LE01038191); vicinity of Glebovka, juniper-Oriental hornbeam-oak forest, [16.05.2009], Popovich (MW0658640); Kamchatka khutor, oak forest, 10.05.2019, Fateryga, Fateryga, Popovich (MW, PHEO). Gelendzhik urban okrug: [vicinity of Kabardinka], rocky slope with *P.[inus] pithyusa* below Doobkiy Lighthouse, 26.05.1929, Maleev (YALT); vicinity of Dzhankhot, forest of *Pinus pallasiana*, 26.05.1975, Dubovic (KW); Arkhipo-Osipovka, in forest of *Pinus pithyusa*, 27.05.1975, Dubovic (KW); vicinity of Svetly village, Tserkovnaya ravine, 06.05.2017, Fateryga, Fateryga, Popovich (PHEO). Tuapse district: vicinity of Dzhubga, south slope of Mt. Shkolnaya, oak-juniper sparse forest, 20.05.1989, Shvedchikova (MW0658638); vicinity of Bzhid, dividing range between Vulkan and Bzhid rivers, Bzhid Pass, oak forest, 25.05.1989, Shvedchikova (MW0658639); Mt. Shkolnaya, Oriental hornbeam sparse forest, 17.05.1992, Chernovol (MHA); Dzhubga, edge of an artificial forest of Crimean pine at the settlement outskirts, 11.05.2019, Fateryga, Fateryga, Popovich (L, MW, PHEO).

Distribution

Russia (Krasnodarsky Krai), Greece, Bulgaria, Turkey (Kreutz, 1998; Govaerts et al., 2005–2020;

Assyov et al., 2012; Delforge, 2016). In Turkey, where both *C. epipactoides* and *C. kurdica* are known, *C. epipactoides* is distributed over the northwest part of the country while *C. kurdica* occupies the southeast (Kreutz, 1998). In Russia, the species is restricted to the Black Sea coastal area of the North Caucasus where it is distributed from the environs of Anapa to Dzhubga (Fig. 3). The easternmost locality shown on the map (Shaumyanskiy Pass) is doubtful due to its isolated position; it was listed in the Red Data Book of Krasnodarsky Krai (Zernov & Popovich, 2017) with the reference to Perebora (2011). The presence of *C. epipactoides* in this place requires further confirmation. There is also one locality listed in the Red Data Book of Krasnodarsky Krai (Zernov & Popovich, 2017) but not shown on the present map (Fig. 3). This is the vicinity of Natukhayevskaya (Novorossiysk urban okrug); Zernov & Popovich (2017) reported this place, while listing the distribution of «*C. cucullata*», with reference to the Herbarium KW. Actually, there are two series of *C. damasonium*, collected in Natukhayevskaya and erroneously identified as *C. epipactoides*, in KW. The first one (seven sheets) was collected on 25.05.1958 by M. Kotov and the second one (five sheets) was collected on 25.06.1959 by M. Kotov, V. Protopopova, and V. Strashko. The latter series also has a duplicate in LE (LE01038193!). As far as there are no correctly identified *C. epipactoides* from the vicinity of Natukhayevskaya in KW, its record from this place by Zernov & Popovich (2017) was obviously erroneous.

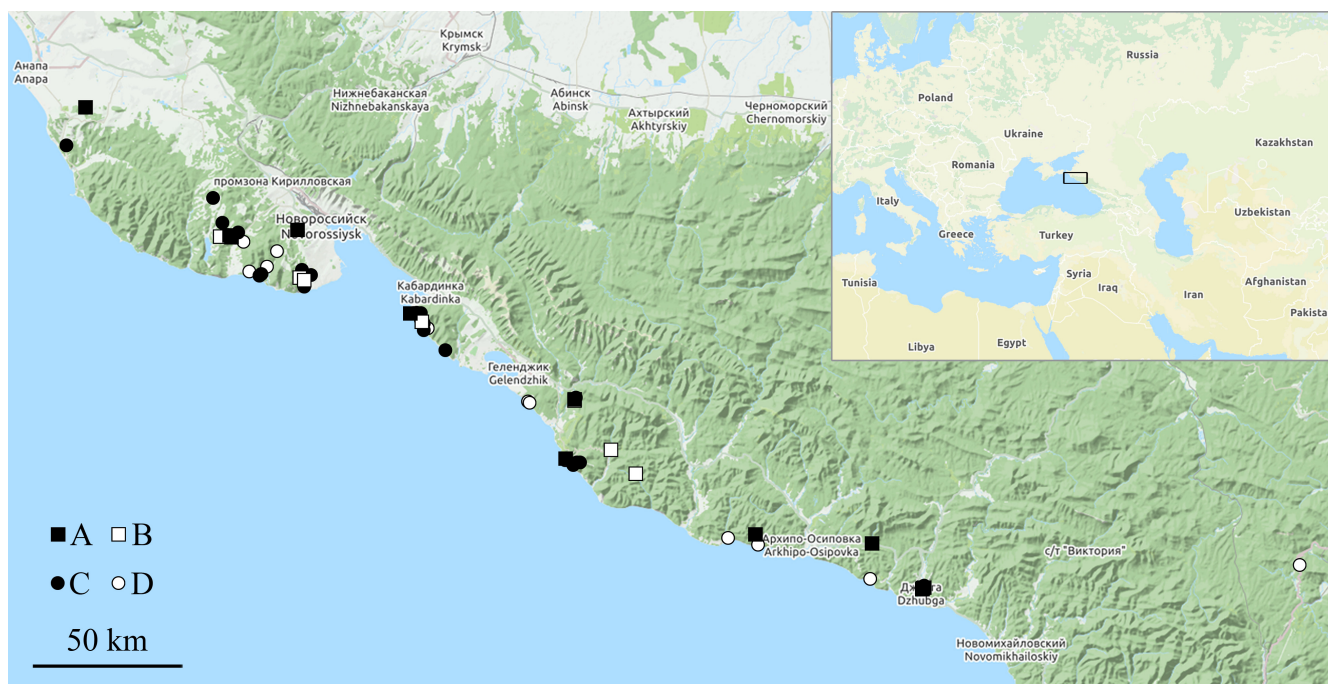


Fig. 3. Distribution of *Cephalanthera epipactoides* Fisch. & C.A. Mey. in Russia. A – specimen-based records; B – data from the «Plantarium» website; C – field observations; D – records from the Red Data Book of Krasnodarsky Krai (Zernov & Popovich, 2017). Background maps were taken from <http://www.openstreetmap.org/>.

Habitats

Primarily, light forest, shrubs, and edges of forests of *Pinus brutia* var. *pityusa* (Steven) Silba, *Juniperus deltooides*, *Quercus pubescens*, and *Carpinus orientalis*, as well as artificial plantations of *Pinus nigra* subsp. *pallasiana*.

Pollination

There are no published data on pollinators of *C. epipactoides* (Claessens & Kleynen, 2011). Experiments revealed that the pollinia can be removed from the flowers with a needle, i.e. the species is probably cross-pollinating. However, no flowers with the pollinia removed by insects were found during the observations. It can be supposed, that the pollinators are solitary bees and the pollination strategy is a food deceptive mechanism, which is known in *C. longifolia* and *C. rubra* (Claessens & Kleynen, 2011).

Conservation status

The species was included to the Red Data Book of the Russian Federation (Vakhrameeva, 2008) under the name *C. floribunda* with the status «2» (decreasing in number = endangered) and to the Red Data Book of Krasnodarsky Krai (Zernov & Popovich, 2017) under the name *C. cucullata* with the status «1» (critically endangered). *Cephalanthera epipactoides* is really critically endangered in Russia. The total number of individuals of this species growing in the Krasnodarsky Krai was estimated as not more than 1000 (Zernov & Popovich, 2017). The species must be included into the next edition of the Red Data Book of the Russian Federation under the correct name (*C. epipactoides*) and with the actual status (critically endangered).

Conclusions

Cephalanthera epipactoides is the correct name for the species which was previously known in Russia as either *C. cucullata* or *C. kurdica* (= *C. floribunda*). The area of its distribution in Russia is isolated from the main part of the species range; the nearest locality in Turkey is near Perşembe, Ordu Province (Kreutz, 1998), which is about 365 km away from Dzhubga (linear distance across the Black Sea). In Russia, *C. epipactoides* has a low population quantity and limited distribution on the Black Sea coastal area of the North Caucasus (along approximately 125 km). The species is highly threatened and requires further studies (e.g. on the pollination ecology).

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СЕРHALANTHERA EPIRACTOIDES (ORCHIDACEAE) В РОССИИ

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Род *Cephalanthera* насчитывает в мировой флоре 20 видов; семь видов известно во флоре России. Один из этих видов, распространенный в России на Черноморском побережье Краснодарского края (Северный Кавказ), является предметом многочисленных неверных определений и таксономической путаницы. Настоящее исследование показало, что данный вид должен называться *Cephalanthera epipactoides*, хотя ранее его приводили для территории России как *C. cucullata* либо *C. kurdica* (= *C. floribunda*). Обозначен лектотип *C. epipactoides*. Приведено морфологическое описание вида с промерами основных параметров. Обобщено распространение *C. epipactoides* в России на основе данных гербариев, сайта «Плантариум», полевых наблюдений авторов и ранее опубликованных сведений; вид распространен здесь вдоль примерно 125 км побережья от окрестностей Анапы до поселка Джубга. Российская часть ареала вида изолирована от основной его части; ближайшее место произрастания в Турции находится примерно в 365 км от Джубги (по прямой). Численность популяции вида в России крайне низкая. *Cephalanthera epipactoides* является в России крайне уязвимым видом, его природоохранный статус – «находящийся под угрозой исчезновения». Необходимо дальнейшее исследование вида, в частности, экологии его опыления.

Ключевые слова: Кавказ, лектотип, орхидеи, Причерноморье, распространение, таксономия